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DECONTAMINATION EQUIPMENT STANDARDS WORKSHOP FOR CIVILIAN FIRST RESPONDERS

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14. ABSTRACT The U.S. Army Edgewood Chemical Biological Center's Decision Analysis Team (DAT) was tasked by the Department of Homeland Security/National Institute of Standards and Technology Standards Development Team to conduct a workshop with first responders to obtain more focused input on important decontamination equipment characteristics. The workshop was a follow-on effort to a survey that the DAT conducted in 2008. Over the course of 2 days in January 2009, the DAT led a structured discussion among the participants in each of the 10 areas relating to decontamination addressed in the survey (time, case of use, reliability/maintainability, operating conditions, transportability, consumable resources required, human factors, interoperability, power requirements, and operational interface) as well as several other topics that had not been previously addressed (e.g., waste management, decontamination efficacy). The Standards Development Team used the results from the workshop to update the draft ASTM standard for civilian first responder decontamination systems.					
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PREFACE

The Department of Homeland Security (Washington, DC) sponsored the production of this material under an Interagency Agreement with the National Institute of Standards and Technology (Gaithersburg, MD). The work was started in October 2008 and completed in February 2009.

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CONTENTS

1.	INTRODUCTION	7
2.	TOPICS NOT ADDRESSED IN THE SURVEY	8
2.1	Decontamination Efficacy	8
2.2	Types of Contamination and Decontamination	9
2.3	Contamination Levels	9
2.3.1	Liability for First Responders	9
2.3.2	Personnel Contamination Level Entering the Decontamination System	9
2.3.3	Personnel Contamination Level Exiting the Decontamination System	9
2.3.3.1	Chemical Contamination	9
2.3.3.2	Biological Contamination	10
2.3.3.3	Radiological/Nuclear Contamination	10
2.4	Technical Versus Mass Decontamination	10
2.5	Waste Management	11
3.	ANSWERS TO FOLLOW-ON QUESTIONS GENERATED FROM THE SURVEY RESULTS	11
3.1	Importance of Characteristics	11
3.2	Time	12
3.2.1	Setup Time for the Decontamination System	12
3.2.2	Continuous Operation of the Decontamination System	12
3.2.3	Time to Decontaminate Ambulatory Persons	12
3.3	Ease of Use	12
3.3.1	Number of First Responders Required for Setup and Operation of the System	12
3.3.2	Training Required	13
3.4	Reliability/Maintainability	13
3.5	Operational Conditions	13
3.5.1	Operational Temperature	13
3.5.2	Operational Wind Speed	13
3.6	Transportability	14
3.7	Shelf-Life (Consumables and Non-Consumables)	14
3.8	Human Factors	15
3.8.1	Operational Noise Level	15
3.8.2	Signage	15
3.9	Interoperability	15
3.10	Power Requirements	15
3.11	Operational Interface	16
3.11.1	Visual Controls and Audible Signals/Alarms	16
3.11.2	Safety	16

4.	CONCLUSIONS.....	16
	GLOSSARY	19
	APPENDIXES	
	A. WORKSHOP PARTICIPANTS	21
	B. STATES AND TERRITORIES IN EACH EPA REGION	23

DECONTAMINATION EQUIPMENT STANDARDS WORKSHOP FOR CIVILIAN FIRST RESPONDERS

1. INTRODUCTION

The U.S. Army Edgewood Chemical Biological Center (ECBC) Engineering Directorate Standards Development Team has been tasked by the Department of Homeland Security [(DHS), Gaithersburg, MD] and the National Institute of Standards and Technology [(NIST), Washington, DC] to write an ASTM Standard for decontamination equipment used by civilian first responders. The standard will address performance and logistical requirements, mechanical properties, and test methods for personnel decontamination equipment that are to be used during a chemical, biological, radiological, nuclear and/or explosive (CBRNE) event. If DHS adopts the ASTM standard, decontamination systems that can be bought with DHS grants will be limited to those systems that are certified to meet the ASTM standard.

A decontamination system would include any powders, solutions, and/or equipment required to physically decontaminate personnel, as well as shelters, power sources (e.g., generators), contamination monitoring equipment, and any other equipment required to move personnel through the decontamination system from the hot (contaminated) zone, where the event has occurred, to the cold (clean) zone. The figure shows an example decontamination line.

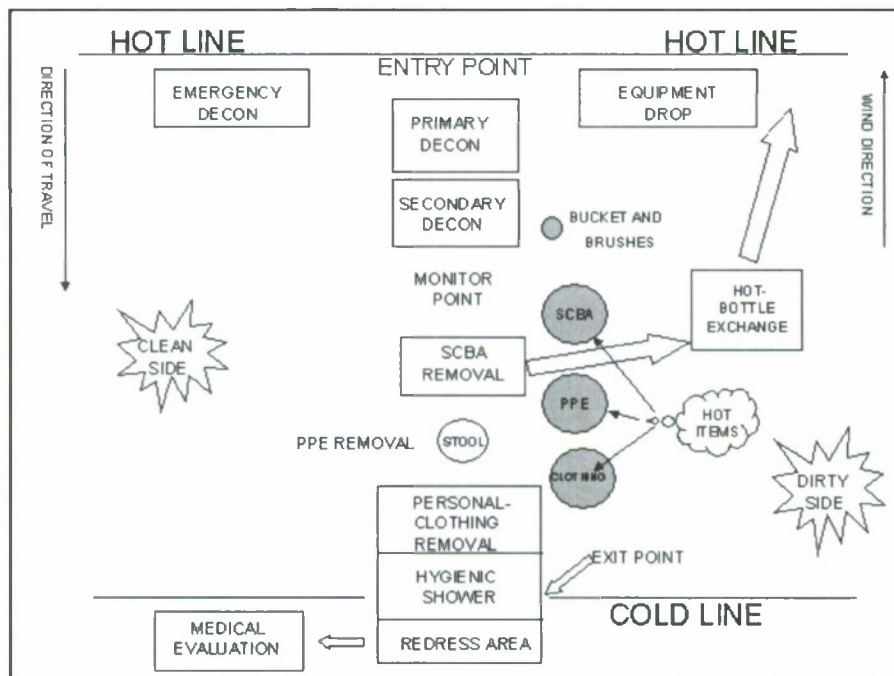


Figure. Example Decontamination Line

Although most first responders currently use wet decontamination (i.e., soap and water) to remove contamination from personnel, the standard will not be specific to the technology or process used to conduct decontamination. Being technology and process

non-specific will ensure that the standard remains relevant as technologies and processes change over time. For instance, future systems may be based on either dry decontamination (e.g., with powders) or mechanical decontamination (which involves removing contamination with tape and then carefully removing clothing and equipment).

In support of the Standards Development Team, the ECBC Decision Analysis Team (DAT) coordinated a survey of the first responder community in the first quarter of FY08 to determine and prioritize decontamination requirements. The survey results were then used to develop draft standards for decontamination equipment. However, the survey prompted additional questions about first responder decontamination equipment. On 21-22 January 2009, the DAT conducted a workshop with a small group of first responders from across the United States along with members of the Standards Development Team to answer questions that were not addressed by the survey, and to verify certain aspects of the survey responses.

First responders who were invited to the workshop were identified from the list of survey respondents and chosen from a variety of geographical and technical backgrounds, with varying levels of decontamination equipment. The participants were chosen to ensure that the decontamination equipment standard created as a result of the workshop and survey would apply to the entire first responder community. The list of workshop participant locations and backgrounds is included in Appendix A.

The remainder of this report documents the key points of the discussions held at the workshop. The workshop discussions focused on the 10 decontamination equipment topics, or characteristics, that were included in the survey, as well as several additional topics. The additional topics are described in Section 2. Section 3 contains workshop participant feedback on topics that were included in the survey. Topics from the FY08 survey that were agreed upon and required neither further input or clarification by workshop participants are not discussed in Section 3.

2. TOPICS NOT ADDRESSED IN THE SURVEY

2.1 Decontamination Efficacy.

Although field monitoring equipment is available for many chemical and biological agents, the capability to monitor the contamination level of people exiting the decontamination system varies greatly among first responders. Some first responders do not have any capability to monitor decontamination efficacy; therefore, the standard should require the manufacturer to provide detailed procedures for the decontamination system. Following said procedures should ensure that personnel processed through the system are decontaminated to a safe level.

2.2 Types of Contamination and Decontamination.

The recommended solution for skin decontamination of chemical, biological, and radiological contaminants is soap and water. Bleach solution is no longer recommended for skin decontamination.

2.3 Contamination Levels.

2.3.1 Liability for First Responders.

The workshop participants stated that liability issues for first responders should be considered in writing the standard, especially if decontamination levels are to be specified. The participants were concerned that a standard for manufacturers would be unofficially viewed as a standard to which first responders must adhere (i.e., first responders must decontaminate to the levels specified in the standard), which could possibly be used against them in a court of law. To mitigate this issue, the standard should explain how it should be used, and note that it is not intended for use as a measure for first responder performance.

2.3.2 Personnel Contamination Level Entering the Decontamination System.

To develop test methods in the standards, the workshop participants suggested that a contamination concentration corresponding to the Immediately Dangerous to Life and Health (IDLH) Level for specific chemicals, or the comparable level for biological or radiological contaminants, be used as the maximum contamination level of people entering the decontamination system.

2.3.3 Personnel Contamination Level Exiting the Decontamination System.

The decontamination system should be able to decontaminate personnel to the level at which the contaminant will no longer harm either the decontaminated person or others. It is assumed that removing clothing prior to entering the decontamination line (referred to as mechanical decontamination) will remove the majority of contamination.

The maximum contamination off-gassing level allowed for people leaving the decontamination system varies based on the type of contaminant, as described in the following sections.

2.3.3.1 Chemical Contamination.

Chemical contamination includes chemical warfare agents (CWAs), toxic industrial chemicals (TICs), and toxic industrial materials (TIMs). Participants felt that the Occupational Safety and Health Administration (OSHA) Short Term Exposure Limits (STELs) may be better post-decontamination contamination levels than Acute Exposure Guideline Levels (AEGLs) as used in the draft standard. Participants felt that AEGLs are too conservative for decontamination systems. Participants from the Aberdeen Proving Ground (APG) Fire Department noted that their contamination monitoring equipment may be based on National

Institute for Occupational Safety and Health (NIOSH) guidelines. Further research is needed to determine which chemical contamination levels (OSHA, NIOSH, or other) are most appropriate.

2.3.3.2 Biological Contamination.

First responders may not be able to measure biological contamination of personnel exiting the decontamination system with the current state of biological detection technology. However, chemical and biological contaminants are decontaminated using the same methods. Participants posed that if the system is capable of decontaminating to the desired level for chemical hazards, then it should be capable of decontaminating to a comparably safe level for biological hazards as well. A safer alternative to this suggestion would be to limit the scope of the standard to either systems or equipment that decontaminates chemical contaminants only, and to update the standard when more advanced biological detection limits and required decontamination levels are developed.

2.3.3.3 Radiological/Nuclear Contamination.

For radiological/nuclear contamination, contamination levels for persons leaving the decontamination line are available from a variety of sources. The following references should be reviewed, and the contamination levels should be analyzed to determine the most appropriate for the standard:

- Handbook for Responding to a Radiological Dispersal Device: First Responder's Guide—the First 12 Hours. (Conference of Radiation Control Program Directors, Inc. (CRCPD), September 2006)
- Occupational Safety and Health Standards, Toxic and Hazardous Substances: Ionizing Radiation. (Standards – 29 Code of Federal Regulations (CFR), Part 1910.1096)
- Terrorism with Ionizing Radiation General Guidance Pocket Guide. (Employee Education System for the Office of Public Health and Environmental Hazards, Department of Veterans Affairs, August 2003)
- Emergency Responder Radioactive Material Quick Reference Sheet. (United States Department of Energy Transportation Emergency Preparedness Program (TEPP), May 2006)
- Radiation Emergency Assistance Center/Training Site (REAC/TS). (Oak Ridge Institute for Science and Education (ORISE) for the United States Department of Energy, <http://orise.orau.gov/rcacts/>, Accessed 10 April 2009)

2.4 Technical Versus Mass Decontamination.

Workshop participants felt that the standard should only address mass casualty, or gross, decontamination of ambulatory people. Mass casualty/gross decontamination is defined as the process of removing contamination, and it applies to any personnel who go through the

decontamination line. Neither technical decontamination nor decontamination of non-ambulatory personnel will be addressed. Technical decontamination is defined as the systematic removal of contaminant, equipment, and clothing, and usually applies to decontaminating only first responders.

2.5 Waste Management.

The workshop participants felt the standard should address how long the decontamination system should be required to contain waste [i.e., what is the waste capacity of the system and how long will it take to reach that capacity (e.g., 2 h) under normal operations?]. Further research needs to be done in this area before a performance requirement is added to the standard.

3. ANSWERS TO FOLLOW-ON QUESTIONS GENERATED FROM THE SURVEY RESULTS

The following sections refer to results of the FY08 survey, which are reported in the document titled, "First Responder Decon Equip Survey Report", dated February 2008.

3.1 Importance of Characteristics.

Respondents to the FY08 survey were asked to rank 10 characteristics of decontamination equipment in order of importance. These characteristics are listed below:

- Time
- Ease of Use
- Reliability/Maintainability
- Operating Conditions
- Transportability
- Consumable Resources Required
- Human Factors
- Interoperability
- Power Requirements
- Operational Interface

The workshop participants agreed with the survey results that Time and Ease of Use are the most important of the 10 characteristics, but felt that the remaining characteristics are of equal importance.

The survey results were also divided and reported for each of the 10 U.S. Environmental Protection Agency (EPA) Regions. The participants felt that the differences in responses between EPA regions were not significant. The states included in each EPA Region are provided in Appendix B.

3.2 Time.

3.2.1 Setup Time for the Decontamination System.

Setup time for the decontamination system is defined as the time for first responders to set up equipment from when it arrives on-site until it is ready for operation. For mass casualty/gross decontamination, the workshop participants suggested designating a maximum setup time of 20 min with an emphasis that a shorter setup time is better so that systems can be developed for those first responders that require a shorter setup time. Shorter setup times may be required by first responders in different locations based on factors such as population density, the size of the state, and urbanization.

3.2.2 Continuous Operation of the Decontamination System.

The decontamination system should be able to run 12 h continuously once it is set up. Waste management over this period of time may be an issue for wet decontamination systems due to the large volumes of water used. However, it is assumed the first responders will make arrangements for waste containment and removal after arriving on site.

3.2.3 Time to Decontaminate Ambulatory Persons.

The participants chose 10 min as the maximum time it should take a single ambulatory person to process through the decontamination system (i.e., throughput time). However, the participants also believed that this may be a high estimate, and other sources should be researched to determine the most appropriate maximum throughput time. Research options include asking manufacturers how they compute their advertised throughput times and asking other organizations what requirements they have for a maximum throughput time.

Other factors should also be considered when determining decontamination time, including age, sex, and/or keeping families together. These factors will increase the time it takes to organize and route people through the system. Also, in an industrial setting, some form of decontamination (e.g., safety showers) may be performed before the first responders arrive on site, which could reduce the level of contamination and associated required decontamination throughput time.

3.3 Ease of Use.

3.3.1 Number of First Responders Required for Setup and Operation of the System.

Workshop participants decided that no more than four first responders should be required to set up the decontamination system. In addition, no more than four first responders should be required at one time to operate the system. As an example, the four responders may be placed in the following positions when operating the system:

- Greeting and explaining decontamination to people entering the system
- Operating ancillary equipment
- Explaining redress and post-decontamination procedures
- Observing safety and fluid levels

Although first responder units may use additional personnel based on their operational needs, the standard should address the maximum number of people required to operate the system as built by the manufacturer.

3.3.2 Training Required.

Decontamination systems should require no more than 8 h of operational training time for first responders who have already received hazardous material training. This time was chosen because teams generally cannot afford having their first responders unavailable for longer than 1 day at a time.

Although the FY08 survey initially addressed training time for first responders to obtain certifications (e.g., in HazMat operations), this type of training will not be considered in the standard. The length of recurring training will also not be addressed in the standard.

3.4 Reliability/Maintainability.

Decontamination equipment should be usable in at least four operations (i.e., four cycles of setup with at least 12 h of continuous use each cycle, and teardown) before requiring care/repairs other than routine post-care and cleaning. In addition, major components, repair parts, and tools required to set up and operate the decontamination system should be commercially and readily available. All required tools should be in English or metric units (i.e., standard SAE tools). The standard should also require the manufacturer to provide routine maintenance documentation for the decontamination system.

3.5 Operational Conditions.

3.5.1 Operational Temperature.

Some geographic areas experience hot and cold conditions (e.g., Illinois and Michigan). Participants recommended that the standard specify a realistic temperature range (0 - 120 °F was suggested) in which equipment needs to remain functional and that extreme cold conditions should not be addressed at this time.

3.5.2 Operational Wind Speed.

First responders may not be able to operate a decontamination system in extremely high winds. For example, Florida first responders will not operate equipment in the

presence of gale force winds (defined as 39-54 mph sustained winds by the National Weather Service). Participants agreed that an acceptable target for maximum sustained wind speed is 30 mph, but recommended that this target value be updated after researching the maximum wind speeds in which manufacturers typically state their decontamination systems can be set up and run.

3.6 Transportability.

There are many unpaved/rough areas over which the decontamination system may need to be transported (such as to railroad tracks where there may be a spill). However, it is unlikely that a large number of people (i.e., a mass casualty scenario) would need to be decontaminated at those types of locations.

The participants suggested that the manufacturer be required to provide a reasonable means (e.g., cart, hand truck) to transport equipment that cannot be towed in a trailer or lifted by an individual person to the required location. More research needs to be performed to determine the following transportability requirements:

- What components should be trailer-able vs. man-portable?
- What should the total size of the decontamination system (in cubic feet) be?
- What should the total weight of the decontamination system be?
- What, if any, individual component weights should be specified?

The standard should also reference the National Fire Protection Association (NFPA) and the Department of Transportation (DOT) regulations for securing equipment during transport (e.g., system should have tie-downs for transport to ensure that equipment arrives safely/securely).

3.7 Shelf Life (Consumables and Non-Consumables).

The shelf life for consumables that are required by the system should be 24 months in non-environmentally controlled storage. A temperature range needs to be specified for this requirement as well; participants suggested -20 - 150 °F. Research is needed to ensure that this requirement will not adversely affect the use of current decontamination consumables (e.g., liquid detergent). If the shelf life of current decontamination consumables such as liquid detergent is <24 months or requires more restrictive storage temperatures, then the requirement for the standard will need to be adjusted. There may also be existing standards for packaging and storage containers for consumables that can be used to develop a reasonable shelf life.

The workshop participants also suggested that non-consumable components of the decontamination system (e.g., tent fabric, hoses, bladders, and pumps) should have a minimum shelf life of 60 months. Environmental storage controls (e.g., temperature and humidity) would need to be specified for this shelf life requirement.

After reviewing the responses for fuel shelf life in the survey, workshop participants felt that the fuel shelf life requirement should not be included in the standard because decontamination system manufacturers cannot control shelf life of the fuels that first responders across the United States will be using.

3.8 Human Factors.

3.8.1 Operational Noise Level.

First responders need to be able to communicate effectively with the public and other first responders while operating the decontamination system. This is complicated by the use of Personal Protective Equipment (PPE), which makes hearing and understanding more difficult. Workshop participants recommended a maximum noise level of 70 dB within the system (e.g., inside the tents), where the public will be processed. A maximum noise level requirement may also be needed for individual pieces of equipment within a certain distance of the decontamination area.

3.8.2 Signage.

The manufacturer should be required to include visual aids that help first responders set up the system. The signs should provide directional cues to prevent the decontamination system from being set up incorrectly. Any additional signage (e.g., instructions to people being decontaminated in the system) should be agreed upon between the manufacturer and the buyer; however, it is preferred that multilingual (e.g., English, Spanish, Braille) and/or pictorial signage be available.

3.9 Interoperability.

Manufacturers should be allowed to determine the appropriate connection and fitting sizes for their systems based on decontamination system performance (e.g., systems that are designed to process more people may need larger fittings). However, internal connections and fittings used in any one decontamination system should be standardized and commercially available. National Standard Thread (NST) should also be required for all supply connections and fittings to the system. Participants also raised the question as to whether the manufacturer should include a coupler/adaptor kit for areas that have custom hose connections on fire hydrants (e.g., Baltimore, MD).

3.10 Power Requirements.

Workshop participants felt that the decontamination system should use 120 V alternating current (AC). However, research is needed on the actual power requirements of typical decontamination systems before the voltage requirement is finalized.

Additional research is needed to determine the amperage required by individual components of typical decontamination systems. The standard may need to specify a total

amperage requirement for the decontamination system, or it may be more appropriate to specify a maximum amperage for any individual component in the system.

The workshop participants also recommended that additional research be performed to determine whether manufacturers should be required to have separate breaker connections for major power-using components (e.g., lights, heater, and pumps). This would allow individual components to be plugged into either a house outlet or separate generator, if necessary.

All components of the system should be protected with Ground Fault Interrupter (GFI) circuits. All components should also be able to be run independently so that if one component trips its breaker, the other components in the system will continue to function normally. Additional requirements are also needed to address weather-resistant exterior electrical junctions and power for emergency/backup lighting.

3.11 Operational Interface.

3.11.1 Visual Controls and Audible Signals/Alarms.

Adjustable gauges, displays, and audible alarms (key indicators with high/low parameters) should be required for all key operating parameters to mitigate safety and ease of use issues. The Underwriters Laboratory (UL) may have test methodology in place to address displays.

The need for manually adjustable controls for key operating parameters will depend on the system. Therefore, the standard needs to be worded so that manufacturers are required to provide manually adjustable controls for the parameters that are important for their types of decontamination systems.

3.11.2 Safety.

The manufacturer should identify all safety issues of the system (e.g., step-ups over berms, pinch and slip hazards) and make them available to system users. Setup, teardown, and operational controls should all be able to be performed in PPE, and all walk surfaces should be slip resistant (reference Standard for the Provision of Slip Resistance on Walking/Working Surfaces, American National Standards Institute/American Society of Safety Engineers (ANSI/ASSE) A1264.2-2006).

4. CONCLUSIONS

The workshop participants identified key performance and logistical parameters and mechanical properties for decontamination systems used by first responders. These parameters and properties will be reviewed, further researched, and translated into requirements for inclusion in the ASTM standard. A summary of the areas requiring additional research is provided below:

- Chemical, Biological, and Radiation Contamination Levels
 - To determine an acceptable level for persons exiting the decontamination line.
- Waste Management
 - To determine the length of operation that the system must contain waste.
- Throughput Times
 - How are manufacturer-advertised throughput times calculated?
 - What requirements do other organizations have for throughput times?
- Wind Speed
 - To determine the maximum wind speed in which first responders will operate.
- Transportability
 - What components should be trailer-able versus man-portable?
 - What should the total size of the decontamination system (in cubic feet) be?
 - What should the total weight of the decontamination system be?
 - What, if any, individual component weights should be specified?
- Shelf Life
 - Effect of shelf life requirements on current decontamination consumables (e.g., liquid detergent).
- Human Factors
 - Noise level requirement for equipment within a certain distance of the system (e.g., generators).
- Interoperability
 - Need for coupler/adaptor kits for areas with custom water line connections (e.g., Baltimore, MD).
- Power Requirements
 - Voltage requirement for decontamination system components.
 - A maximum amperage for the system and/or for individual system components.

- Need for separate breakers for major power-using components (e.g., lights, heater, and pumps).
- Operational Interface
 - Need for manually adjustable controls (gauges, displays, alarms) for key operating parameters.

After developing the requirements for the standard, test methods for verifying that the decontamination systems meet the requirements will be developed. Once finalized, the ASTM standard will provide first responders with the ability to discriminate between commercially-available decontamination systems. Systems that have been certified to the standard will have verified performance and functionality.

GLOSSARY

AEGL	Acute Exposure Guideline Levels
ANSI/ASSE	American National Standards Institute/American Society of Safety Engineers
APG	Aberdeen Proving Ground
BWA	Biological Warfare Agent
CBRNE	Chemical Biological Radiological Nuclear Explosive
CFR	Code of Federal Regulations
CRCPD	Conference of Radiation Control Program Directors, Inc.
CWA	Chemical Warfare Agent
DAT	Decision Analysis Team
DHS	Department of Homeland Security
DOT	Department of Transportation
ECBC	U.S. Army Edgewood Chemical Biological Center
EPA	U.S. Environmental Protection Agency
GFI	Ground Fault Interrupter
HazMat	Hazardous Material
IDLH	Immediately Dangerous to Life and Health
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NST	National Standard Thread
ORISE	Oak Ridge Institute for Science and Education
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
REAC/TS	Radiation Emergency Assistance Center/Training Site
STEL	Short Term Exposure Limits
TEPP	Transportation Emergency Preparedness Program
TIC	Toxic Industrial Chemical
TIM	Toxic Industrial Material
UL	Underwriters Laboratory

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APPENDIX A
WORKSHOP PARTICIPANTS

The following list shows the type of participation received from first responders across the United States.

<u>Location</u>	<u>Type of Responder</u>
Florida	- Retired local law enforcement officer
Illinois	- Illinois State Police nuclear safety engineer who is also a fire fighter, hazmat team member, and EMT
Kentucky	- Public health planner who is also a hazmat team member
Maryland	- Aberdeen Proving Ground Fire Department fire chief and assistant chief - Harford County Emergency Operations Center hazmat team member
Michigan	- Fire fighter with experience as a hazmat team member
Mississippi	- County fire department preplanning officer with experience as a fire fighter

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APPENDIX B

STATES AND TERRITORIES IN EACH EPA REGION

